Space Weather Technical Forecast

Issued on Thursday, 25 November 2021 at 00:43 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 late Day 3 (27th) or early Day 4 (28th Nov). High energy electrons probably reaching active threshold during diurnal maximums.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was very low, with no significant flares detected. There is currently one numbered a active region (AR2898) in view, with AR2896 and AR2897 in the west both small and simple uni-polar spots, now faded. AR2898 in the southeast has displayed further growth and is currently Dri/Beta configuration. An Earth-directed coronal mass ejection (CME) may affect Earth late on 27 Nov or early on 28 Nov.
Solar Wind / Geomagnetic Activity: Solar wind speeds, as measured by DSCOVR at L1, declined from 500-520 km/s to near 450 km/s. Density values were near average. Total IMF Bt was weak at 1-5 nT, with an unremarkable north-south component Bz of +5/-4 nT. Phi angle remained in a negative (towards the sun) orientation. Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. The high energy electron flux (greater than 2 MeV) was at predominantly moderate levels, and reached high levels through the diurnal cycle, with 1610 pfu recorded at 24/1605 UTC. Associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a continued rising trend. 6.8e7 integrated pfu recorded at 24/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be at low or very low levels, with a chance of C-class flares.

Solar Wind / Geomagnetic Activity: An Earth-directed CME is currently forecast to reach Earth late on Day 3 or early on Day 4 (27 or 28 Nov). Solar winds are expected to return to slow-ambient values over the next 24 hours under waning high speed stream influences, with Quiet geomagnetic activity. However, further enhancement is currently predicted late on Day 3 or early on Day 4 (27 or 28 Nov) due to the CME arrival with Unsettled to Active and a chance (20%) of G1, but this is low confidence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is expected to reach moderate to high levels through the diurnal cycle, with a slight chance of associated 24-hour integrated fluence reaching the active threshold from Day 2 (26 Now) onwards

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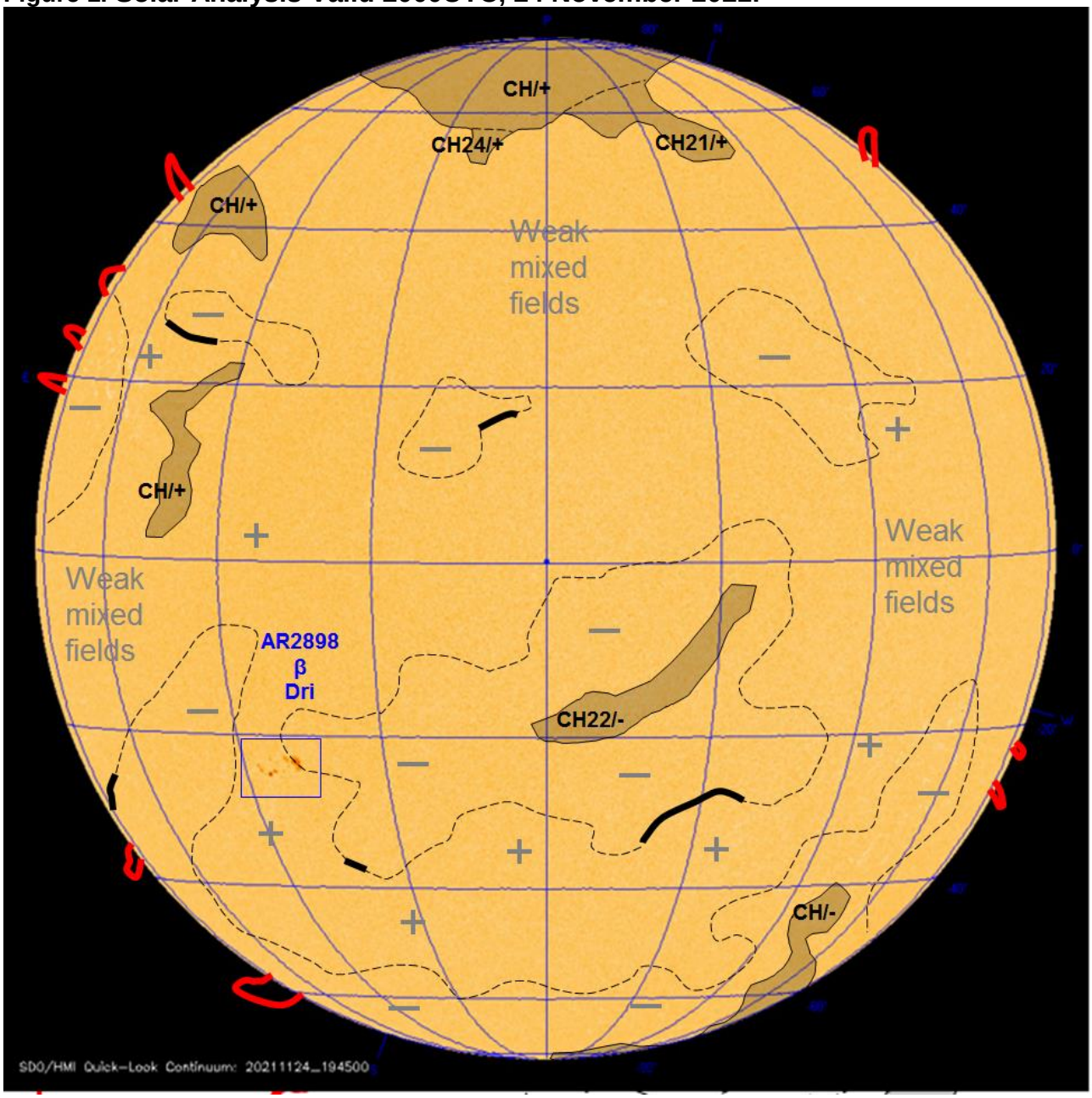
Figure 1. Solar Analysis Valid 2000UTC, 24 November 2021.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

An Earth directed CME is currently forecast to reach Earth either late on day 3 (27 Nov) or early on day 4 (28 Nov).
Solar winds should slowly return to slow-ambient levels during the next 24 hours as the fast wind from CH20 continues to erratically wane. Any further enhancements to the solar wind are then low confidence for the rest of the period, with possible weak influences from CH21, an extension of the northern polar crown around day 2 (26 Nov). Earth may then connect with a high speed stream from negative CH22, just south of the equator, by day 3 (27 Nov), and later on day 3 or early on day 4 (28 Nov) the forecast CME may arrive with an enhancement to solar winds back up to slightly elevated or elevated levels.
STEREO A data showed some increasingly disturbed solar wind parameters on 23rd, which might be expected three days later at Earth, on 26 Nov (day 2). However, this included a switch to a positive sector of the sun's surface, making CH22 effects unlikely, and with no significant increase in solar wind speeds.
Quiet geomagnetic activity expected for the next couple of days, with an increased chance of Unsettled to Active intervals on day 3 (27 Nov), especially later in the day, and a slight chance of G1 (minor geomagnetic storm intervals - mainly for day 4 (28 Nov).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	10	20
Strong	G3	No	1	1	1	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/20:58UTC	Partial halo	Filament eruption	SE	500	27.2300UTC	Limited shock expected

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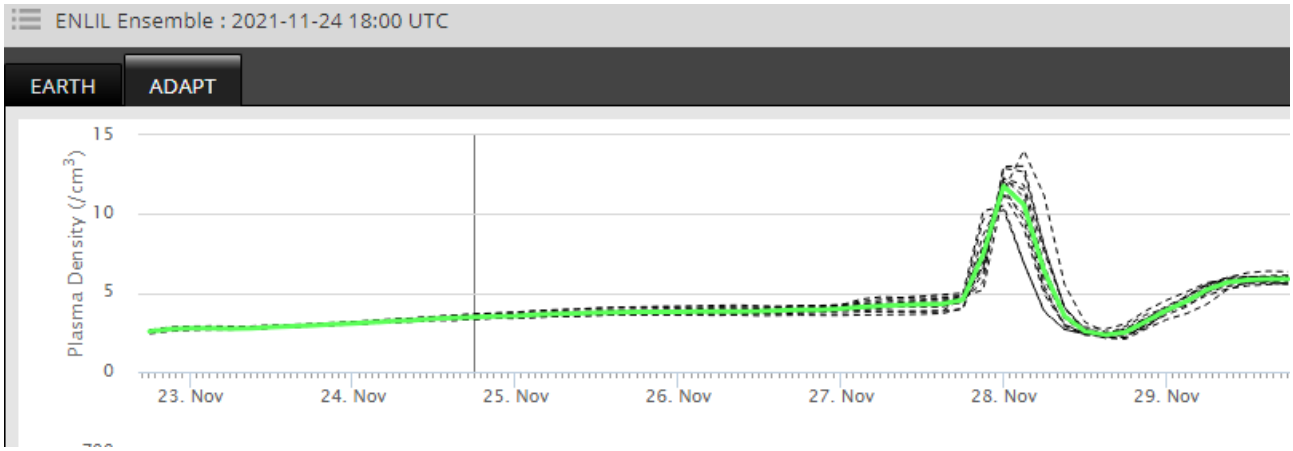
Radio Blackouts - X-Ray Flares:
Solar activity is currently very low, and expected to remain at low or very low levels, with no significant flares expected from the current small and magnetically simple sunspot regions on the visible disc. However, the Beta sunspot in the southeast will be monitored for further increases in complexity and this gives a chance (25%) of a C-class flare. A further bright flux region evident in STEREO EUVI imagery may indicate a further active region, this may have been the source of a CME early on 23rd, and is likely to move into view over the southeast horizon on day 1 (25 Nov).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: Met Office Adapt ENLIL ensemble currently indicating arrival of the CME at Earth early on 28 Nov.



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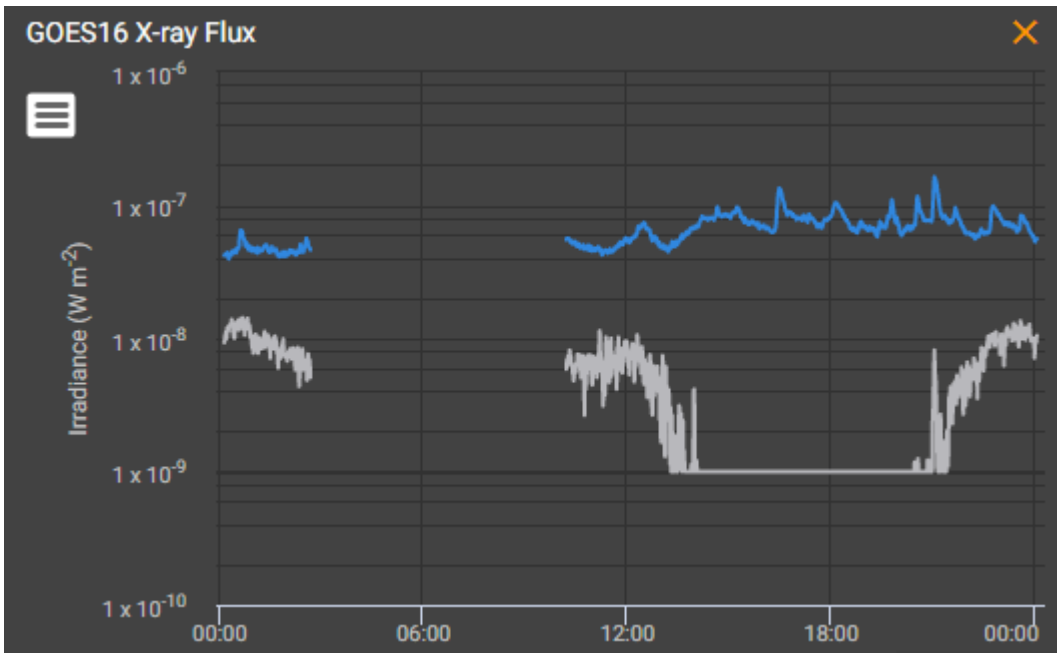
Solar Radiation Storms - (High Energy Protons):
In the absence of any significant flare activity, the high energy proton flux (greater than 10 MeV) is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: X-ray flux plot, from GOES 16, showing limited solar activity with very low levels currently.



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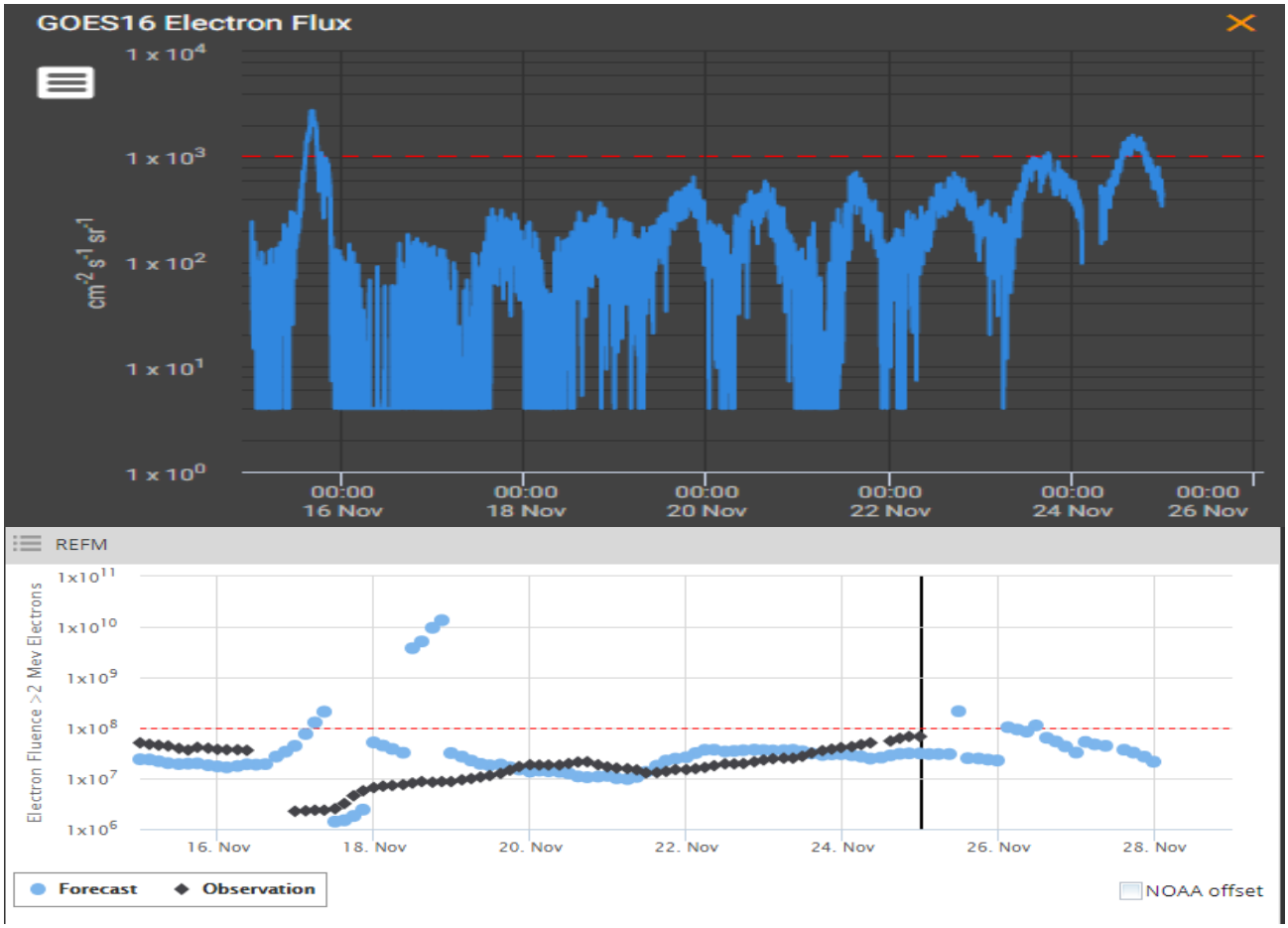
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO reached high levels through the diurnal cycle on 24 Nov. A repeat of this pattern is likely for the next two or three days but confidence is rather low. By day 4 (28 Nov) the anticipated arrival of the CME is likely to reduce electron counts.
Corresponding electron fluence will probably remain below the active threshold (1e8 integrated pfu). MOSWOC REFM output is giving reasonable guidance to start the period, but the current reset to higher values on 25 Nov is considered unrealistic.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	20	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: High energy electron flux and Met Office REFM output since mid-month



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